

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
26 February 2004 (26.02.2004)

PCT

(10) International Publication Number
WO 2004/017378 A3

(51) International Patent Classification⁷: **H01L 21/31,**
21/469

(21) International Application Number:
PCT/US2003/025739

(22) International Filing Date: 18 August 2003 (18.08.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/404,371 18 August 2002 (18.08.2002) US

(71) Applicants (*for all designated States except US*): **AVIZA TECHNOLOGY, INC.** [US/US]; 440 Kings Village Road, Scotts Valley, CA 95066 (US). **INTEGRATED PROCESS SYSTEMS, LTD.** [KR/KR]; 33 Jije-dong, Pyunglaek, Kyungki-do (KR).

(72) Inventors; and

(75) Inventors/Applicants (*for US only*): **LEE, Sang-In** [KR/US]; 22608 San Juan Road, Cupertino, CA 95014 (US). **SENZAKI, Yoshihide** [JP/US]; 400 Clubhouse Drive, Aptos, CA 95003 (US). **LEE, Sang-Kyoo** [KR/KR]; #201, 17-22 Yangjae 1 Dong, Suhcho-Gu, Seoul (KR).

(74) Agents: **SWIATEK, Maria, S. et al.**; Dorsey & Whitney LLP, 4 Embarcadero Center, Suite 3400, San Francisco, CA 94111 (US).

(81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

- with international search report
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

(88) Date of publication of the international search report:
6 May 2004

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: ATOMIC LAYER DEPOSITION OF HIGH K METAL SILICATES

(57) Abstract: The present invention relates to the atomic layer deposition ("ALD") of high k dielectric layers of metal silicates, including hafnium silicate. More particularly, the present invention relates to the ALD formation of metal silicates using metal organic precursors, silicon organic precursors and ozone. Preferably, the metal organic precursor is a metal alkyl amide and the silicon organic precursor is a silicon alkyl amide.

WO 2004/017378 A3

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US03/25739

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : H01L 21/31, 21/469

US CL : 438/681, 758, 785

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 438/681, 758, 785

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
NONE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

USPAT WEST

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y,P	US 6,465,371 B2 (LIM) 15 October 2002 (15.10.2002), column 3, lines 55-65.	1-25
Y	US 6,203,613 B1 (GATES et al) 20 March 2001 (20.03.2001), column 8, lines 10-60.	1-25



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:		"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search

24 NOVEMBER 2003

Date of mailing of the international search report

08 MAR 2004

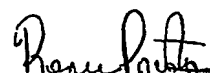
Name and mailing address of the ISA/US
Commissioner of Patents and Trademarks
Box PCT
Washington, D.C. 20231

Facsimile No. (703) 305-3230

Authorized officer

ALEXANDER G. GHYKA

Telephone No. (703) 308-0661



(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property
Organization
International Bureau



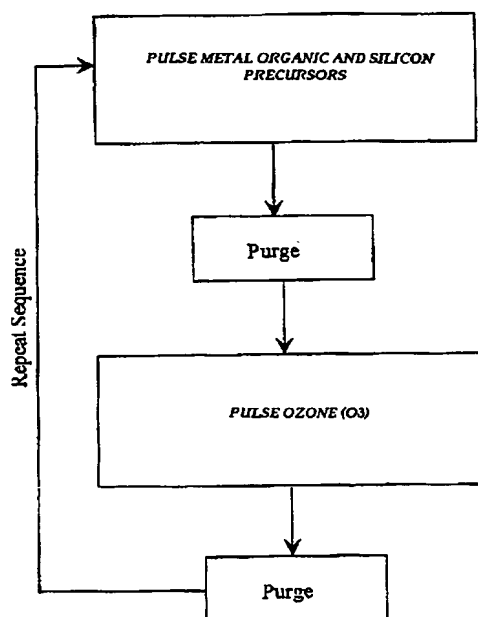
(43) International Publication Date
26 February 2004 (26.02.2004)

PCT

(10) International Publication Number
WO 2004/017378 A2

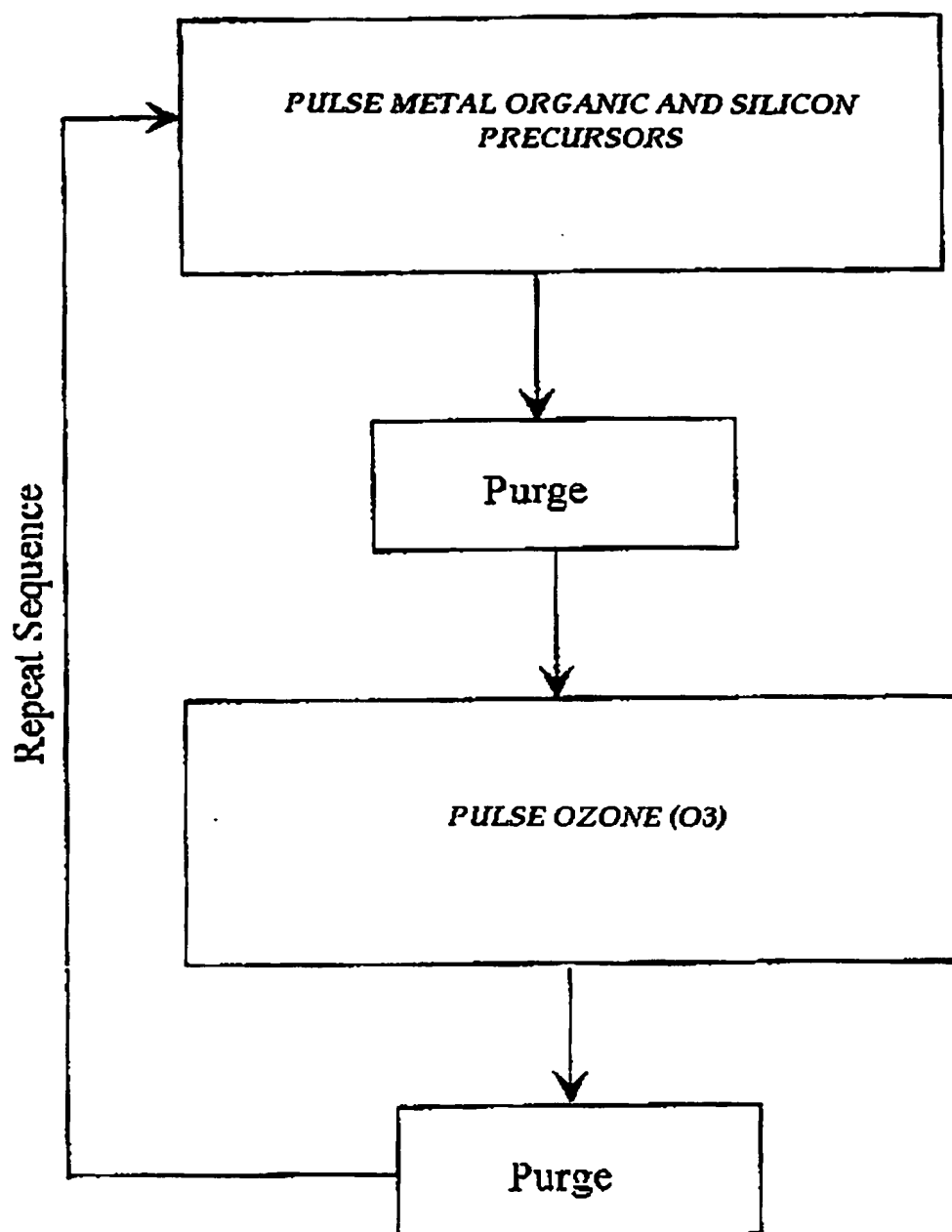
- (51) International Patent Classification⁷: **H01L**
- (21) International Application Number:
PCT/US2003/025739
- (22) International Filing Date: 18 August 2003 (18.08.2003)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
60/404,371 18 August 2002 (18.08.2002) US
- (71) Applicant (for all designated States except US): ASML
US, INC. [US/US]; 440 Kings Village Road, Scotts Valley,
CA 95066 (US).
- (72) Inventors; and
- (75) Inventors/Applicants (for US only): LEE, Sang-In
[KR/US]; 22608 San Juan Road, Cupertino, CA 95014
(US). SENZAKI, Yoshihide [JP/US]; 400 Clubhouse
Drive, Aptos, CA 95003 (US). LEE, Sang-Kyoo [KR/KR];
#201, 17-22 Yangiae 1 Dong, Suhcho-Gu, Seoul (KR).
- (74) Agents: SWIATEK, Maria, S. et al.; Dorsey & Whitney
LLP, 4 Embarcadero Center, Suite 3400, San Francisco, CA
94111 (US).
- (81) Designated States (national): AE, AG, AL, AM, AT, AU,
AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU,
CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH,
GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC,
LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW,
MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC,
SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA,
UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.
- (84) Designated States (regional): ARIPO patent (GH, GM,
KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW),
Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),
European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE,
ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO,
SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM,
GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).
- Published:**
— without international search report and to be republished
upon receipt of that report
- For two-letter codes and other abbreviations, refer to the "Guid-
ance Notes on Codes and Abbreviations" appearing at the begin-
ning of each regular issue of the PCT Gazette.

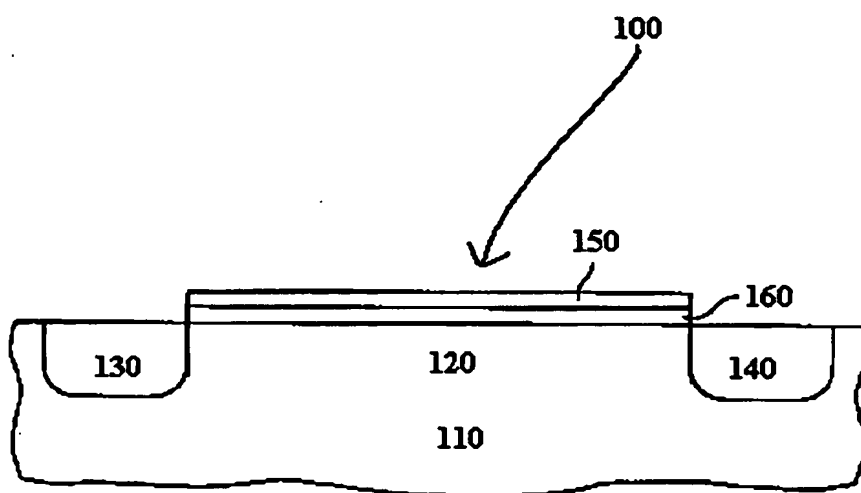
(54) Title: ATOMIC LAYER DEPOSITION OF HIGH K METAL SILICATES



(57) Abstract: The present invention relates to the atomic layer deposition ("ALD") of high k dielectric layers of metal silicates, including hafnium silicate. More particularly, the present invention relates to the ALD formation of metal silicates using metal organic precursors, silicon organic precursors and ozone. Preferably, the metal organic precursor is a metal alkyl amide and the silicon organic precursor is a silicon alkyl amide.

WO 2004/017378 A2

*FIG. 1*

*FIG. 2*